Abstract ID: 16843 Title: Radiation hardness of the storage phosphor europium doped potassium chloride for radiation therapy dosimetry

Purpose: An important property of a reusable dosimeter is its radiation hardness, that is, its ability to retain its dosimetric merits after irradiation. The radiation hardness of europium doped potassium chloride (KCl:Eu2+), a storage phosphor material recently proposed for radiation therapy dosimetry, is examined in this study.
Methods: Pellet-style KCl:Eu2+ dosimeters, 6 mm in diameter and 1 mm thick, were fabricated in-house for this study. The pellets were exposed by a 6 MV photon beam or in a high dose-rate 137Cs irradiator. Macroscopic properties, such as radiation sensitivity, dose response linearity, and signal stability, were studied with a laboratory photostimulated luminescence (PSL) readout system. Since phosphor performance is related to the state of the storage centers and the activator, Eu2+, in the host lattice, spectroscopic and temporal measurements were carried out in order to explore radiation-induced changes at the microscopic level.
Results: KCl:Eu2+ dosimeters retained 40% of their initial signal strength after a 5000 Gy dose history. Sensitivity recovered to nearly 90% via a high-temperature annealing procedure. Dose response was initially supralinear over the dose range of 50-500 cGy but became more linear with dose history. Measured data fit a linear approximation to within an average of 2% after 200 Gy to 5000 Gy dose history. There were no significant changes in the PSL stimulation spectra, PSL emission spectra, photoluminescence spectra, or luminescent lifetime, indicating that the PSL signal process remains intact after irradiation but at a reduced efficiency due to recoverable radiation-induced perturbations in the crystal lattice.
Conclusions: Systematic studies of KCl:Eu2+ material are important for understanding how the material can be optimized for radiation therapy dosimetry purposes. The data presented here indicate that KCl:Eu2+ exhibits strong radiation hardness and lends support for further investigations of this novel material.

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